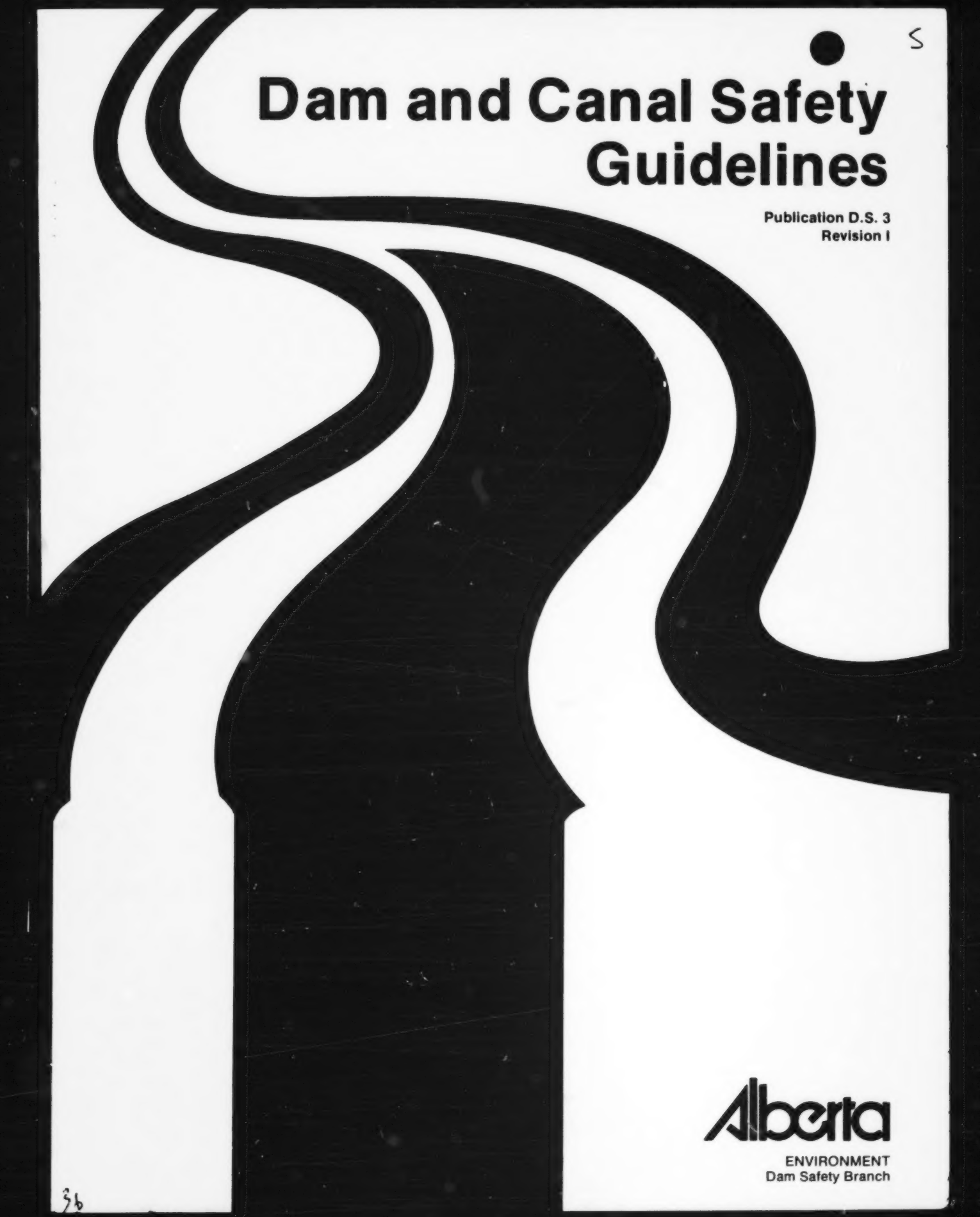
Dam and Canal Safety Guidelines

Publication D.S. 3
Revision I



Alberta

ENVIRONMENT
Dam Safety Branch

THE WATER RESOURCES ACT
DAM AND CANAL SAFETY REGULATION

GUIDELINES

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January 1983

NOTE: These guidelines replace those published in February, 1979, and are in metric units.

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THE WATER RESOURCES ACT
DAM AND CANAL SAFETY REGULATION
GUIDELINES

INTRODUCTION

On September 19, 1978, Alberta became the first province to have a Dam and Canal Safety Regulation.

This booklet, Guidelines, explains the working of the Regulation as it is being administered by the Dam Safety Branch of Alberta Environment.

LICENSING

Before any water retaining structure is constructed the person (or company) undertaking the project requires authorization pursuant to section 11 of the Water Resources Act to divert and use water. To obtain authorization, the applicant must apply to the Controller of Water Resources and, if successful, will receive an Interim Licence. This will state the quantity of water that can be used and it will allow construction of the scheme based on certain drawings and specifications submitted with the application.

The Controller of Water Resources has certain requirements before an application can be processed. These requirements are stated in the Water Resources Regulations.

If a structure is 8 metres or more in height or 60,000 cubic metres or more in capacity the Controller of Water Resources will refer the application to the Dam Safety Branch for review.

For Dam Safety to complete a review, certain additional information is required as discussed later in the Guidelines. Existing dams, canals and appurtenant structures that meet the criteria of the Regulation will be subject to periodic inspection to ensure that they remain in a stable and safe condition.

The Licensee is responsible for the construction of a new structure or operating and maintaining an existing structure in a manner such that the structure is, and remains, stable and safe. The Licensee is also responsible for the cost of any repair work required by the Dam Safety Branch and will be expected to keep the works in good repair.

DELEGATION OF POWERS

Some of the powers of the Minister in the Regulation have been delegated to the Dam Safety Branch Head. Therefore, a notification, direction or other order prescribed in the Regulation signed by the Dam Safety Branch Head has the same authority as if it had been signed by the Minister.

UNDERSTANDING THE REGULATION

The Dam Safety Regulation must be read in conjunction with the Water Resources Act to obtain a full understanding of the legislation. Copies of the Act and Regulation are available from the Queen's Printer.

The Regulation is filed as Alberta Regulation 351/78.

NEW STRUCTURES

The Water Resources Regulations 5.1(1) state that, "The Controller of Water Resources shall, before granting or refusing an application for a licence or approval or for an amendment of a licence or approval involving the construction, repair, improvement, change, alteration, replacement, suspension, abandonment, or removal of a dam or canal as defined in the Dam and Canal Safety Regulation (Alta. Reg. 351/78), refer the application to the Head of the Dam Safety Branch of the Department.

When an application is referred to the Dam Safety Branch, the drawings and other documents related to the proposed structure will be evaluated to ensure that the structure has been fully detailed and sufficient design analysis has been undertaken by the applicant and/or his engineering representative.

To enable the Dam Safety Branch to evaluate the proposed structure, the following list of information (List A) must be provided when filing an application with the Controller of Water Resources.

List A is meant to cover all types of structures. Variations in the content of the information is left to the discretion of the individual engineer submitting the information.

While the Dam Safety Branch does not expect to receive highly detailed information on each project, inevitable delay will occur in the processing of an application if insufficient information is presented.

Certain structures may be subjected to an in-depth evaluation by Dam Safety Branch depending on the size, hazard potential, location or other factors concerning the structure. In these cases, the Dam Safety Branch may ask for additional information regarding the project. List B includes some of the areas for which additional information may be required.

On receipt of the required information, the Dam Safety Branch will evaluate the proposed structure and recommend to the Controller that the application be approved or rejected.

It should be noted that, at the discretion of the Dam Safety Branch, evaluations may be made either by Department staff or private engineering consultants.

LIST A

REQUIRED INFORMATION TO BE SUBMITTED WITH APPLICATION FOR LICENCE
(See Typical Drawings - Appendix C)

1. Key plan showing principal topographic features of the drainage area (watershed) and downstream channel at an appropriate scale.

2. General plan of dam and adjacent areas at an appropriate contour interval showing location of all appurtenant structures and reference bench marks.

   General plan of dam and reservoir at an appropriate scale showing borrow areas, extent of reservoir, water surface area and reservoir capacity curves.

3. Centerline profile of dam showing the following:

   a) crest elevation
   b) FSL (full supply level) and MWL (maximum water level)
   c) natural ground surface
   d) depth and nature of underlaying strata as shown by test pits or borings
   e) probable depth of excavation for foundation or cut-off
   f) location and dimensions of conduit outlets

4. Typical cross-section(s) of dam at maximum section showing:

   a) embankment slopes and dimensions
   b) position, dimensions and material of any cut-off wall
   c) nature and dimensions of any slope protection
   d) position and dimensions of any zoned material, filter layers, rock toes, etc.

5. Gradation curves of granular filter materials and soil being protected.

6. Detailed plan(s) of spillway showing:

   a) variation of cross-sectional area with grade
   b) width and shape of crest
   c) length of spillway (centerline profile)
   d) grade and shape of approach and discharge channels
   e) layout of upstream and downstream erosion protection
   f) dimensions of floors, walls, etc.
   g) spillway rating curve and design discharge (flood discharge and frequency of event)
   h) tailwater rating curve.

7. Detailed plan(s) of outlet works showing locations and dimensions of all valves or sluice gates, intakes, trash racks, outlet towers, gate houses and appurtenant structures.

8. Sub-surface exploration results showing (as necessary):

   a) depth to bedrock (where exploration taken to bedrock)
   b) classification of both rock and soil underneath the dam and its appurtenant structures
   c) illustrated logs of all holes with depth to water table and dates of measurement recorded
   d) results of other tests performed
   e) all unusual surface and sub-surface geological features
   f) details of construction materials

9. Miscellaneous plans of construction features not covered above such as piling, fish ladders, flash boards, timber details, radial gates or mechanical operating devices, etc.

10. Construction specifications

11. Proposed construction schedule

LIST B

ADDITIONAL INFORMATION

1. Reports of watershed condition, hydrologic studies and model studies

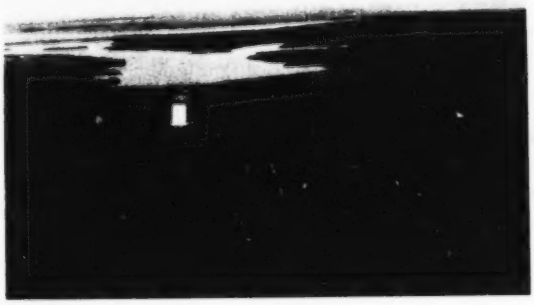
2. Plans for handling stream diversion during construction

3. Flood inundation maps

4. Calculations showing analysis of embankment reservoir stability including effect of rapid drawdown of the reservoir

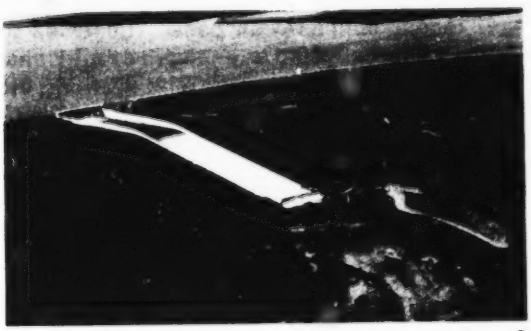
5. Schedule of first filling of reservoir

6. Additional information required at discretion of Dam Safety Branch.



St. Mary's Dam

Waterton Dam



EXISTING STRUCTURES

The Dam and Canal Safety Regulation allows inspections of dams and canals and their associated appurtenant structures to determine if they are safe.

The administrative process associated with the Dam and Canal Regulation is detailed below. Parts and Sections referred to are parts and sections in the Regulation.

1. Section 1 defines various terms used in the Regulation.
   In Section 1(1)(b), "canal" also includes: syphons, flumes, ditches, aqueducts, etc. that meet the capacity criteria, i.e. are capable of conducting 5 cubic metres/sec. or more.
   In Section 1(1)(c), "dam" also includes the foundations and abutments, the reservoir and its outer perimeter, spillways,, penstocks, conduits and outlet works and other flood or riparian controls.

2. The Minister has delegated his powers detailed in sections 2(a), 2(b), 4,5,6,9, and 14(2) to the Head of the Dam Safety Branch.

3. Part 1—Inspection, allows the Dam Safety Branch Head to obtain existing information on individual structures, arrange an initial site inspection and proceed to obtain extra information, if required, to determine the condition of the structure.

4. Section 2 requires that within 90 days of being requested by the Head of the Dam Safety Branch, the Licensee must supply all existing data on the dam or canal and arrange a site inspection. The Licensee and any person giving technical advice to the Licensee may accompany the Dam Safety Branch staff during this inspecion.

5. Section 4 requires that the Licensee supply additional information, as requested, to the Dam Safety Branch Head so that he may evaluate the condition of the dam or canal.

6. If the dam or canal is small (i.e., generally farm dams, small irrigation projects, privately licensed structures) the Dam Safety Branch Head may request that certain work be carried out by the Licensee to determine the condition of the structure.

7. For the larger structures, mainly dams, the Dam Safety Branch Head will require that the Licensee report on the condition of the structure. The report must identify any deficiencies and make recommendations regarding repairs, modifications, etc. to ensure the project is safe. The report must contain a recommended date for future inspections and reports.

8. The Licensee may, within 60 days of being requested by the Dam Safety Branch Head to supply extra information or reports, notify the Dam Safety Branch Head that he is engaging an independent professional engineer to obtain the information or prepare the reports. The Licensee would normally be allowed up to one year for this work.

9. The Dam Safety Branch Head may decide that the information or report is inadequate and that further information or work is required. The Dam Safety Branch Head may direct the Licensee to obtain further information or do such other and further things as necessary (Section 5).

10. The Dam Safety Branch Head will review the information and/or reports received and may recommend a review panel. The review panel, consisting of three independent professional engineers, would be engaged by the Department to review the information and recommend to the Minister the repairs, modifications, etc., required to ensure the project is safe.

11. If the Licensee objects to the Dam Safety Branch Head's directive on the grounds that the extra information or other things are not necessary to determine the condition of the dam or canal, the Licensee may engage a review panel.

    The resort to a review panel would only be available if a review panel had not previously been engaged by the Minister.

12. The Dam Safety Branch Head may determine that the information or report is sufficient to determine the condition of the dam or canal. If no further work is required on the dam or the canal, the Dam Safety Branch Head will inform the Licensee accordingly and may prescribe a date when a further inspection will be required.

13. Section 6 allows the Dam Safety Branch Head to direct the Licensee to make such repairs, improvements, changes to, or replacements of all or part of the dam or canal as he considers necessary for the safety of any person or property affected or likely to be affected by the dam or canal.

14. Section 7 allows the Minister, upon failure of the Licensee to make repairs, etc., to arrange for the repairs, etc., to be completed and recover the cost from the Licensee.

15. Section 10 requires that the Licensee hold an interim licence before making repairs if the Act requires an interim licence for that purpose. To find out if an interim licence is required, the Licensee should contact the Controller of Water Resources.

16. Section 14, Notification of the Minister, can be effected by notifying the Head of the Dam Safety Branch.

GENERAL INFORMATION

1. Licensees or other persons requiring further information on the working of the Regulation should contact the Dam Safety Branch.

2. Licensees requiring engineering advice should contact:

   Alberta Environment
   Dam Safety Branch
   3rd Floor, Oxbridge Place
   9820 - 106 Street
   Edmonton, Alberta
   T5K 2J6
   Phone: (403) 422-1355

   The Dam Safety Branch will give general advice but for particular problems will refer the Licensee to one of the other agencies listed below.

   Prairie Farm Rehabilitation Administration (P.F.R.A.)
   Department of Regional Economic Expansion
   Government of Canada

   P.F.P.A. will give design and construction advice to farmers and ranchers in the prairie provinces. They also give financial assistance up to certain limits.

   Association of Professional Engineers, Geologists and
   Geophysicists of Alberta (A.P.E.G.G.A.)
   215 - One Thornton Court
   Edmonton, Alberta
   Phone: (403) 426-3990

   A.P.E.G.G.A. can supply the names of consulting engineers experienced in the areas of concern. A.P.E.G.G.A. does not offer advice on particular problems.

   Alberta Environment
   Design and Construction Division
   8th Floor, Oxbridge Place
   9820 - 106 Street
   Edmonton, Alberta
   T5K 2J6
   Phone: (403) 427-6150

Design and Construction Division will give general advice and under certain circumstances may undertake design work and construction.

3. To contravene the Regulation is an offence under the Water Resources Act. The penalty can be as much as $1,000 for a person, or $5,000 for a corporation for each offence. The consequences of failure of a dam or canal may be more serious if damage or loss of life results.

APPENDIX A

FREQUENCY OF INSPECTION

In general, the dams falling within the Regulation will be initially inspected as soon as possible with the priority being decided by the size classification and hazard potential classification as shown on the attached tables 1 and 2.

The frequency of inspection for each dam or canal will depend on many variables, including availability of staff, funding of the Dam Safety Program and the results of the initial inspections.

Those structures categorized as either "large" or "high" will be inspected first. Structures with previously disclosed defects or repair requirements will also be given high priority.

TABLE 1

Size Classification

To classify a dam use the value of height or storage that gives the larger size category.

Category	Storage (dam^3)*	Height (m)
Small	60 to 1000	Below 12
Intermediate	1,000 to 50,000	12 - 30
Large	Over 50,000	Over 30

*NOTE: 1 cubic decametre ($1 dam^3$) = $1000 m^3$

TABLE 2

Hazard Potential Classification

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (No permanent structures or habitation downstream.)	Minimal (Undeveloped to occasional structures or agriculture.)
Significant	Few (No urban developments and no more than a small number of inhabitable structures.)	Appreciable (Notable agriculture, industry or structures.)
High	More than a few (Permanent Village or urban development.)	Excessive (Extensive industry or agriculture.)

HAZARD POTENTIAL

The hazard potential of a structure depends on the physical size of the structure, the capacity and the downstream habitation and environment. It is not dependent on the actual condition of the structure.

The hazard potential rates only the consequences of failure of the structure. It is used as a means of determining the recommended spillway project flood and thus the size of the spillway. It is also used to assess the importance of each structure so that frequency of evaluation of the structure may be compatible with its hazard potential.

TABLE 3

Recommended Project Flood

The recommended project flood can be obtained by using the categories from the previous Tables 1 and 2 and selecting the appropriate value from Table 3.

Size Classification Hazard Potential	Small	Intermediate	Large
Low	100 yr.	100 yr. to 0.5 P.M.F.	0.5 P.M.F.
Significant	100 yr. to 0.5 P.M.F.	0.5 P.M.F.	0.75 P.M.F.
High	0.5 P.M.F. to P.M.F.	P.M.F.	P.M.F.

P.M.F. = Probable maximum flood

Routed Project Flood

For each individual project, the selected project flood (i.e. 1:100 year, P.M.F.) should be calculated by an acceptable method and routed through the basin, reservoir and outlets.

Spillway Capacities

The dam must be capable of passing the routed project flood without causing failure of the dam. Limited damage may be sustained provided it does not affect the integrity of the dam. In passing the routed project flood all available outlets should be considered.

For dams that are required to pass a project flood greater than the 1:100 year flood, the reservoir can be assumed to be at dam crest elevation during routing. No allowance for freeboard due to wave action need be considered. Dams required to pass the 1:100 year project flood should have a minimum freeboard of 3 feet.

Service Spillways, Emergency Spillways and Outlets

The sizing of the various outlets is left to the judgment of the design engineer with the following limitation on the design of the service or operating spillway:

The service or operating spillway for dams designed for the 1:100 year flood must be able to safely pass a minimum of the 1:20 year flood with a minimum of 3 ft freeboard.

In all cases, specific data must be supplied for the reservoir showing details of the freeboard calculations.

APPENDIX B

OTHER PUBLICATIONS BY DAM SAFETY BRANCH

D.S. 4. Inventory of Dams - 1979 - The Inventory lists all of the dams coming within the terms of the Regulation.

D.S. 5. Inspection of Small Dams.
This is a booklet designed to help the owners of small dams recognize problems occurring on their dams.

Both publications are available through the Dam Safety Branch.

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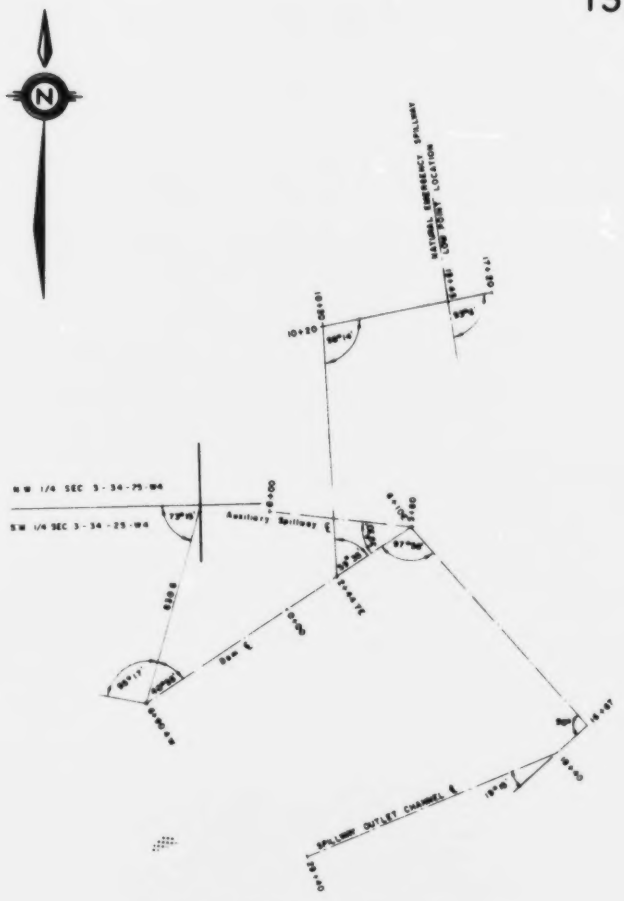
GENERAL PLAN
SCALE 1" = 200'


N
NATURAL EMERGENCY SPILLWAY LOW POINT LOCATION
10+20
NW 1/4 SEC 3 - 34 - 25 - W4
SW 1/4 SEC 3 - 34 - 25 - W4
Auxiliary Spillway
Dam
SPILLWAY OUTLET CHANNEL

CENTRELINE LOCATION PLAN
SCALE 1" = 300'

NOTE
REFER TO AS CONSTRUCTED CENTRELINE LOCATION PLAN ON PLATE No 3A OF 18

WEST OF 4th MERIDIAN

ALBERTA DEPARTMENT OF AGRICULTURE
WATER RESOURCES DIVISION
DESIGN BRANCH

H144C

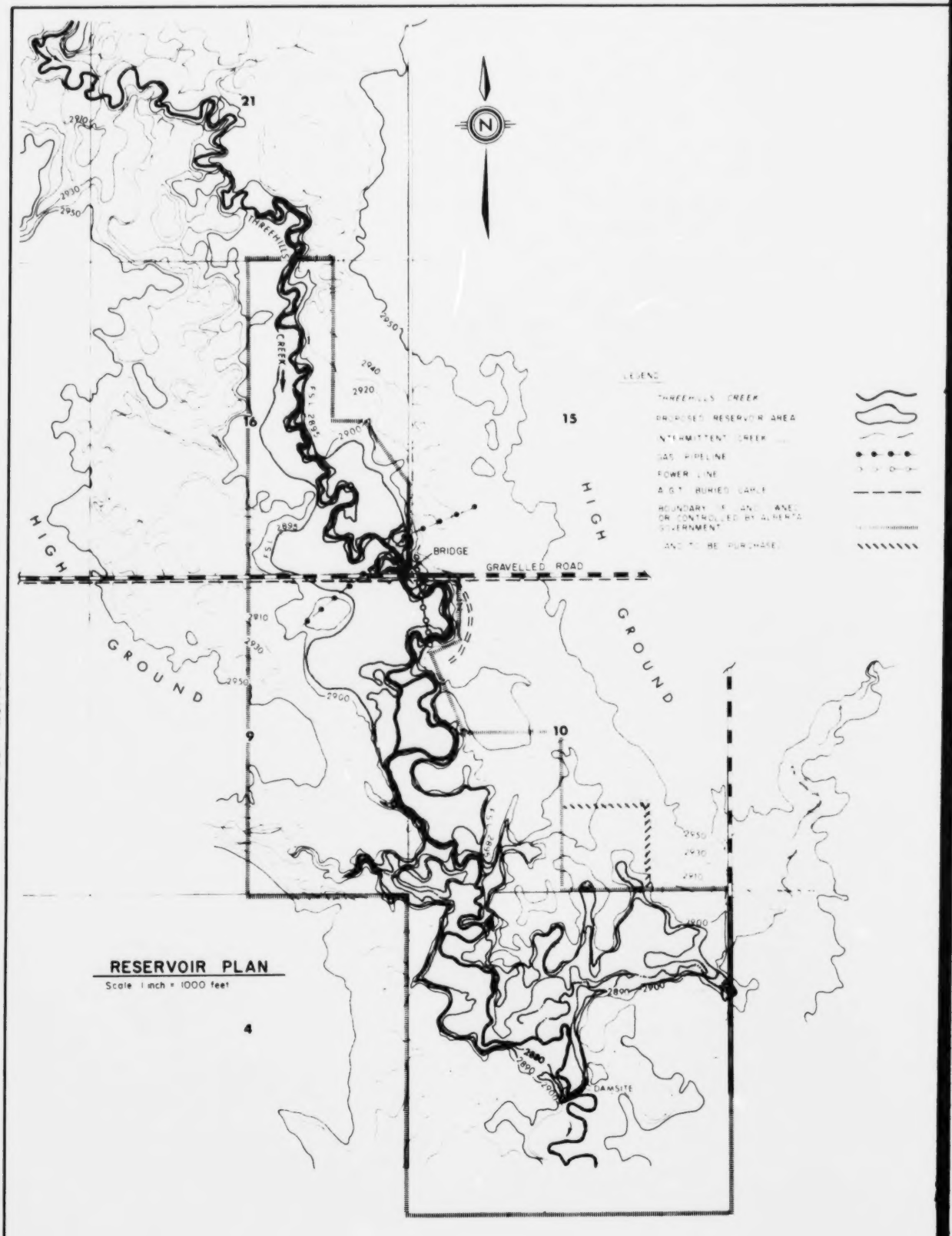
GENERAL AND CENTRELINE LOCATION PLAN

Scale As shown Date March, 1971 Sheet 1 of 2

Submitted by
Date
Approved by
Date

Designed by
Drawn by
Checked by

PLATE No. 3 of 18



RESERVOIR PLAN

Scale 1 inch = 1000 feet

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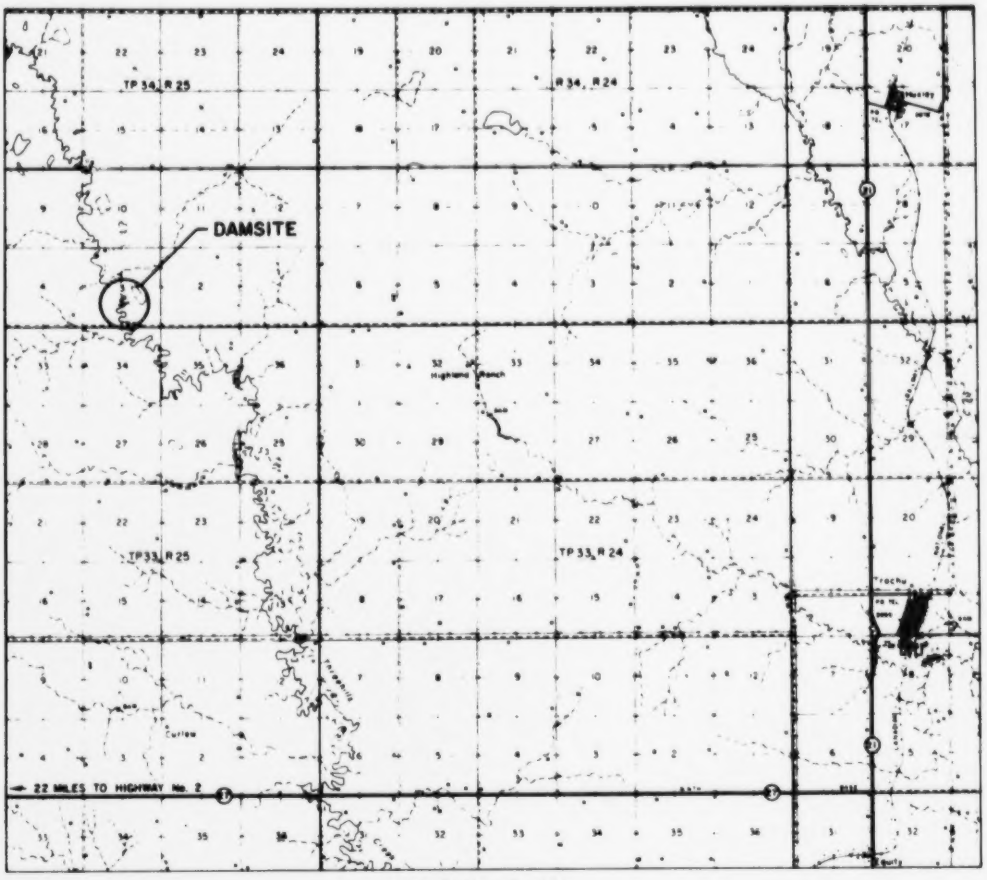
13290 - 1



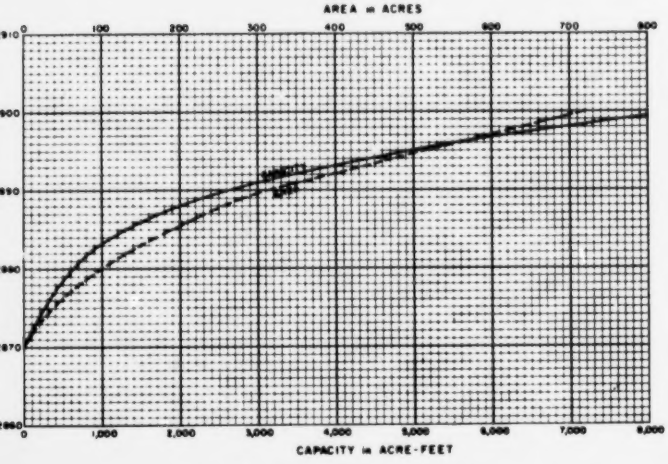
LOCATION PLAN

Scale 1 inch = 1 mile

HER MAJESTY IN THE RIGHT OF ALBERTA
Applicant

Per:

Minister of Agriculture — Date 22-3-71



AREA - CAPACITY CURVES

WEST OF 4th MERIDIAN

ALBERTA DEPARTMENT OF AGRICULTURE
WATER RESOURCES DIVISION
DESIGN BRANCH

H144C

RESERVOIR PLAN

Scale As shown — Date March, 1971 — Sheet 1 of 1

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Date

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Drawn by T. Zeoth
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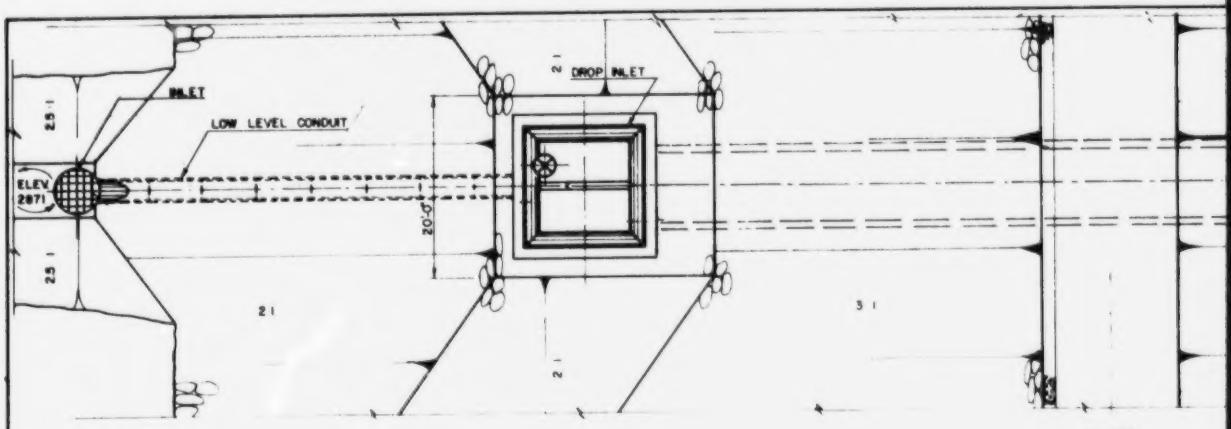
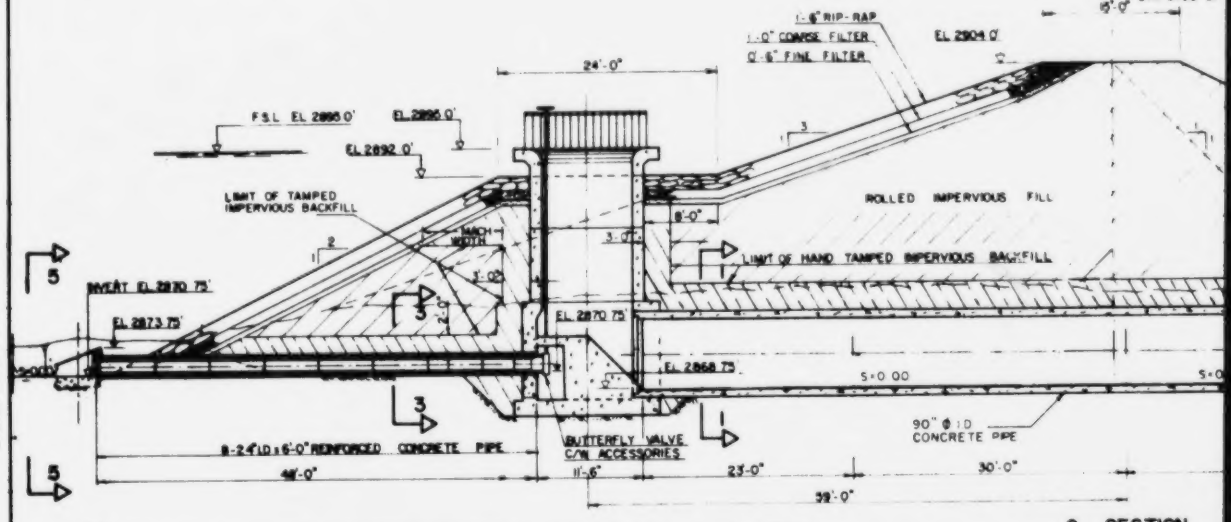
PLATE No. 1 of 18



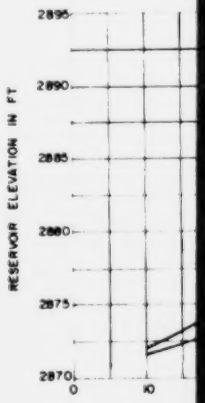
PLAN

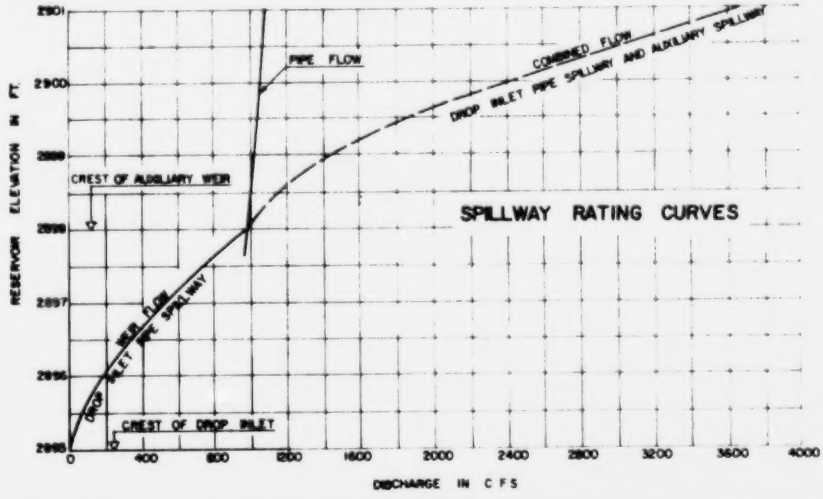
SCALE 1/8"=1'-0"



℄ SECTION

SCALE 1/8"=1'-0"





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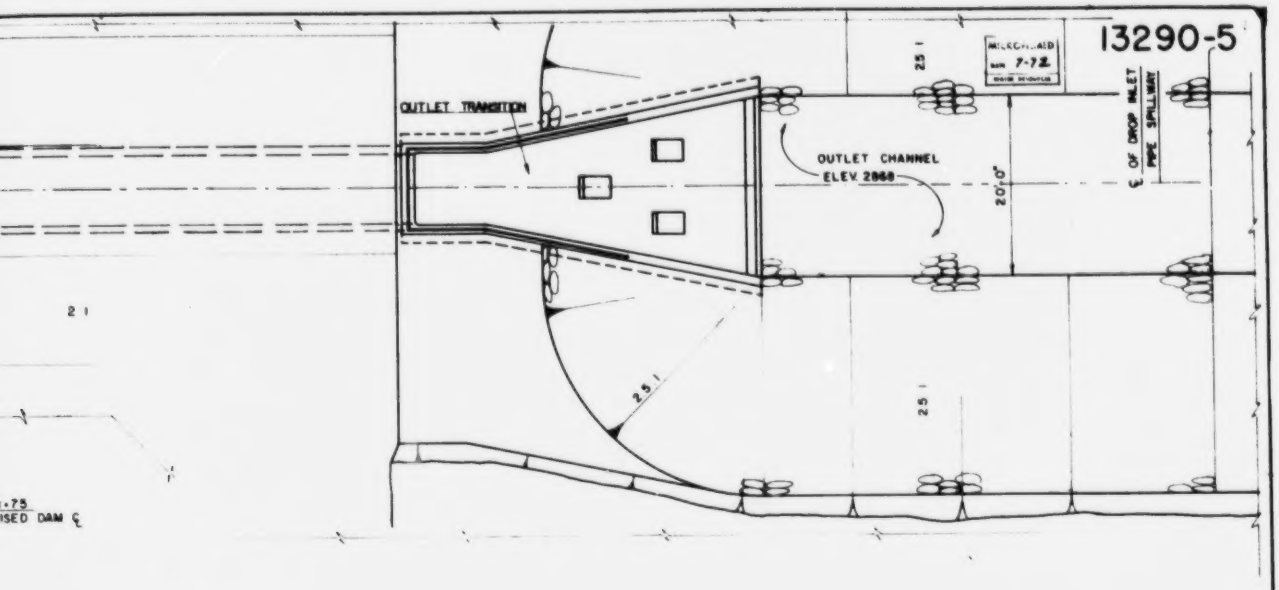

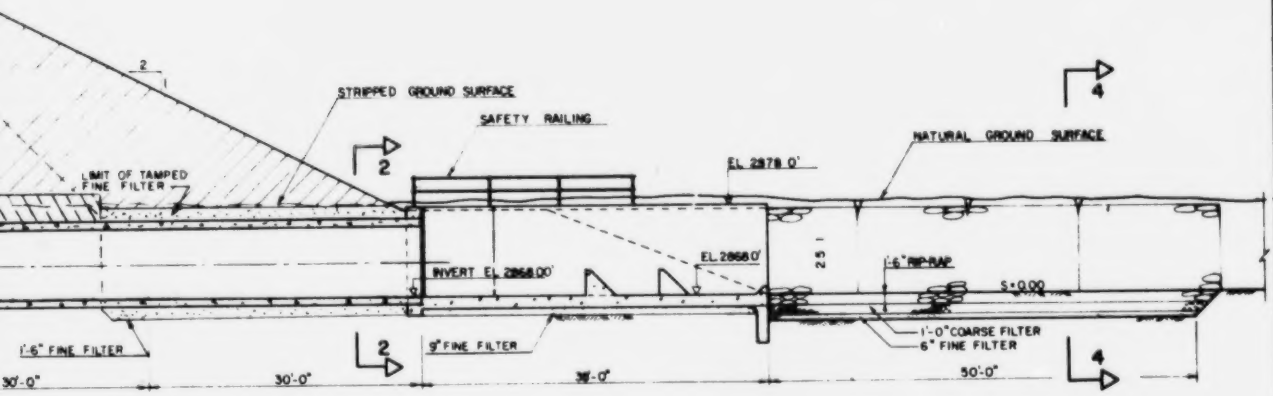

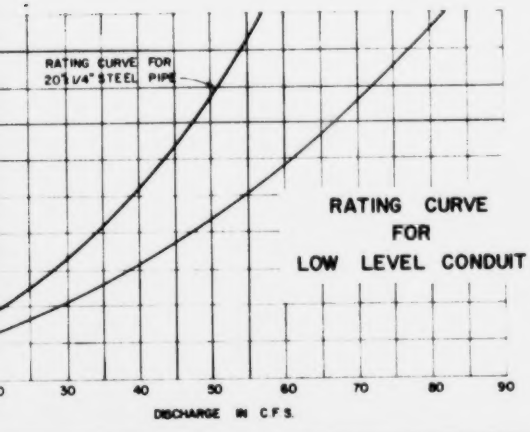

RATING CURVE
FOR
LOW LEVEL CONDUIT

ALBERTA DEPARTMENT OF AGRICULTURE
WATER RESOURCES DIVISION
DESIGN
BRANCH

H144C

DROP INLET PIPE SPILLWAY
PLAN & SECTION

Scale As Shown Date March, 1971 Sheet 4 of 1

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PLATE No. 4 of 18

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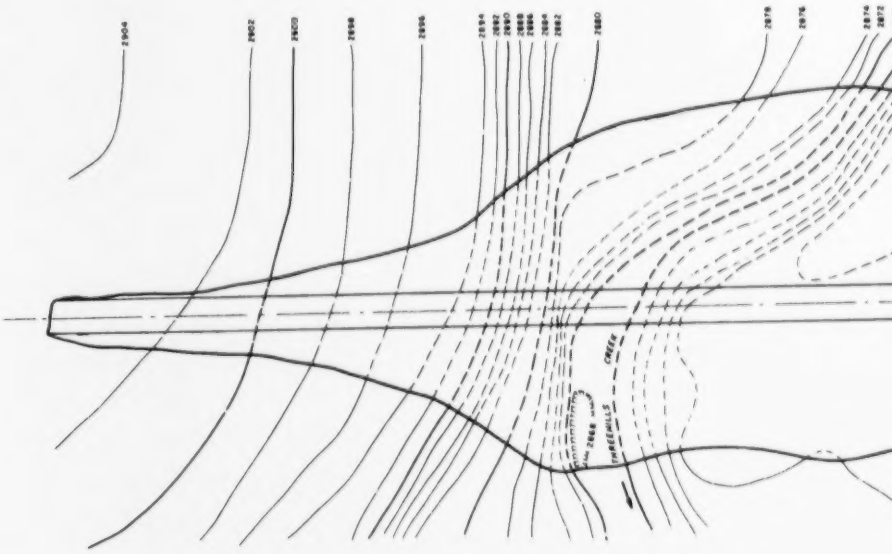
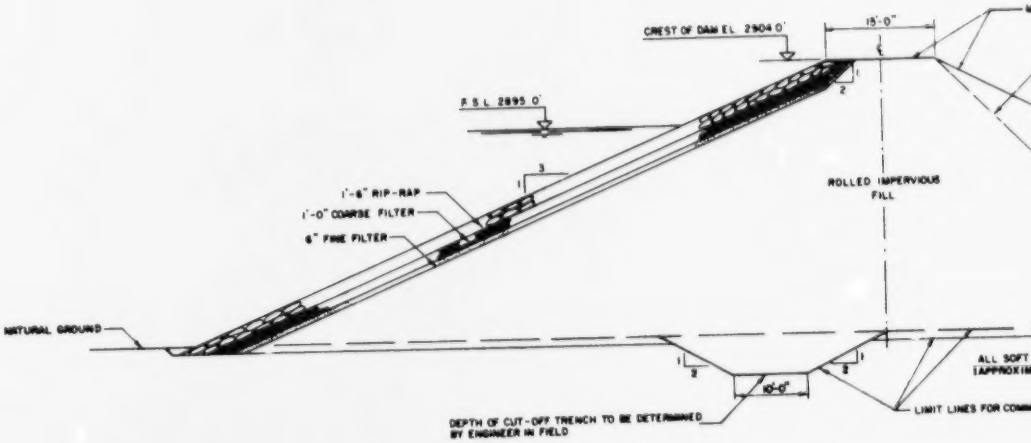


PLAN

SCALE 1" = 30'



TYPICAL DAM SECTION

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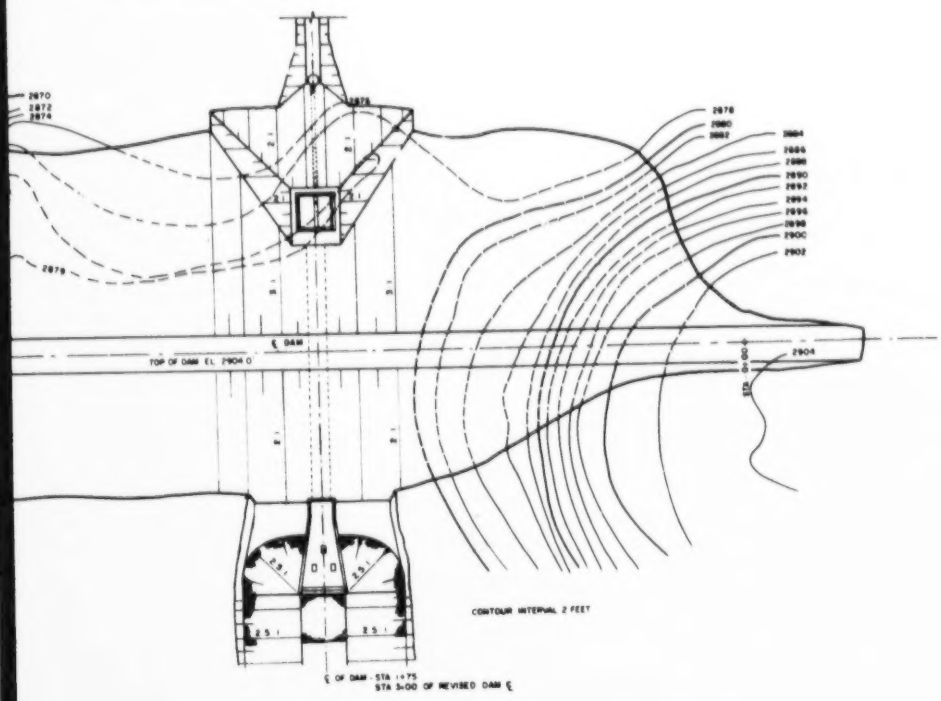
WATER RESOURCES

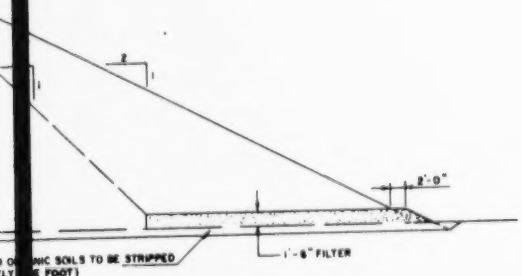


NOTES

1) CREST TO SLOPE 1 40 UPSTREAM
2) CUT-OFF TRENCH TO EXTEND UP THE VALLEY SIDES TO F.S.L. 2895.0'
3) FILTER TO EXTEND UP THE VALLEY SIDES TO F.S.L. 2895.0

" LAYER OF GRAVEL

FILTER LOCATION LINE



NIC SOILS TO BE STRIPPED
E FOOT)

ATION

SCALE REFERENCE
ONE INCH

ALBERTA DEPARTMENT OF AGRICULTURE
WATER RESOURCES DIVISION
DESIGN
BRANCH

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EMBANKMENT PLAN AND DETAIL

Scale AS SHOWN
Date June, 1971
Sheet 1 of 1

Submitted by
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Designed by J.H.J.
Drawn by
Checked by J.H.J.

PLATE No. 15 of 18